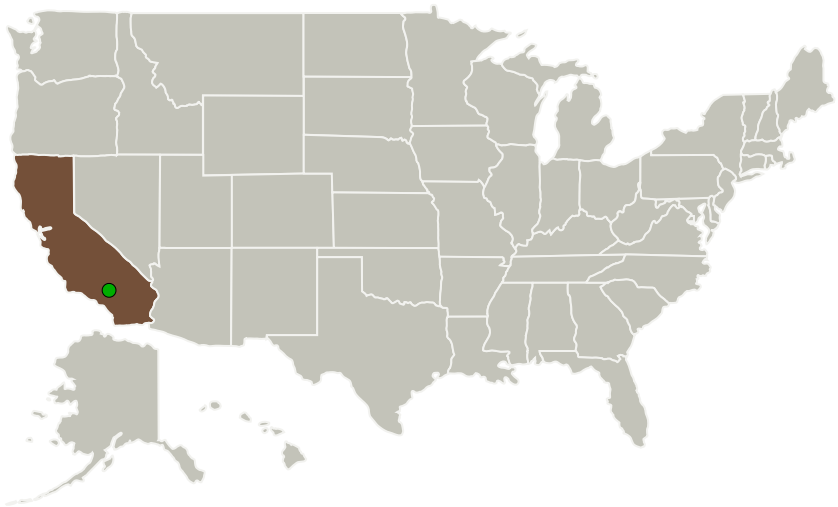
Aeroservoelastic Suppression of LCO due to Free-Play Using a Combined Analytical and Experimental Approach, Phase I

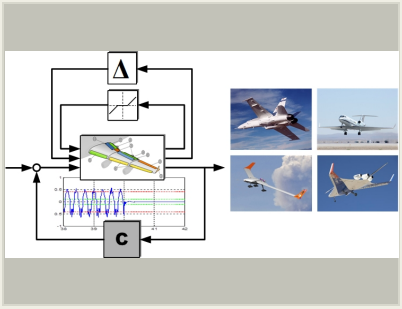
Completed Technology Project (2014 - 2014)

Project Introduction

Aerodynamic control surfaces with excessive free-play can cause limit cycle oscillations (LCO), a sustained vibration of constant amplitude that is caused by a combination of aeroservoelastic effects and free-play. The LCO can impact handling qualities, ride quality and can cause structural fatigue, ultimately leading to structural failure. Due to the negative impacts of free-play induced LCO, very stringent absolute free-play limits have been established for control surfaces on both military and commercial aircraft. Systems Technology, Inc. (STI) and Boeing propose to develop an innovative, robust, and reliable active control concept that alleviates the adverse effects of control surface free-play, relieving costly requirements associated with manufacturing, inspection, and part replacement. The solution involves a novel linear fractional transformation framework for relevance to models of varying complexity and a robust control approach that exploits the piecewise-linear nature of the free-play nonlinearity. To aid in control design and to provide practical real-world relevance, a combined analytical and experimental approach is proposed by the STI-Boeing team. The proposed solution is minimally intrusive, providing for application to a wide array of existing and future aircraft (including both high speed fighters and transport aircraft), ultimately resulting in significant cost savings and increased pilot safety.

Primary U.S. Work Locations and Key Partners





Aeroservoelastic suppression of LCO due to free-play using a combined analytical and experimental approach Project Image

Table of Contents

Small Business Innovation Research/Small Business Tech Transfer

Aeroservoelastic Suppression of LCO due to Free-Play Using a Combined Analytical and Experimental Approach, Phase I

Completed Technology Project (2014 - 2014)

Organizations Performing Work	Role	Type	Location
Systems Technology, Inc	Lead Organization	Industry	
Armstrong Flight Research Center(AFRC)	Supporting Organization	NASA Center	Edwards, California

Primary U.S. Work Locations
California

Project Transitions

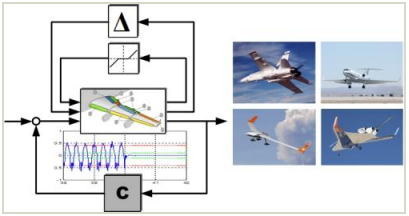
June 2014: Project Start

December 2014: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/137782)*

Images



Project Image
Aeroservoelastic suppression of LCO due to free-play using a combined analytical and experimental approach Project Image *(https://techport.nasa.gov/image/131115)*

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
Systems Technology, Inc

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

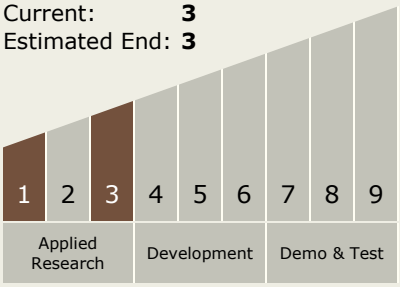
Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Brian P Danowsky

Technology Maturity (TRL)

Start: **1**
Current: **3**
Estimated End: **3**



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Completed Technology Project (2014 - 2014)

Technology Areas

Primary:

- TX02 Flight Computing and Avionics
  - TX02.1 Avionics Component Technologies
    - TX02.1.3 High Performance Processors

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System